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| 10/755,490 | 01/12/2004 | Richard E. Smalley | 11321-P034D1 | 1978 |
| 7590 | 11/17/2004 | | EXAMINER | |
| Ross Spencer Garsson | | | TSOY, ELENA | |
| P.O. Box 50784 | | | | |
| Dallas, TX 75201-0784 | | | ART UNIT | PAPER NUMBER |

1762

DATE MAILED: 11/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/755,490

Applicant(s)

SMALLEY ET AL.

Examiner

Elena Tsoy

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 28-50 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 28-43 and 46-49 is/are rejected.
- 7) ☒ Claim(s) 44,45 and 50 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 5/27/04.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Response to Preliminary Amendment

1. Preliminary Amendment filed on January 12, 2004 has been entered. Claims 1-27 have been cancelled. New claims 47-50 have been added. Claims 28-50 are pending in the application.

Claim Objections

2. Claims 29 and 30 are objected to because of the following informalities: "comprises" should be changed to -- comprise -- .
3. Claim 48 is objected to because of the following informalities: "single-wall carbon nanotubes" should be changed to -- the aggregates of -- single-wall carbon nanotubes --.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (c) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. **Claims 28-38, 43, 48** are rejected under 35 U.S.C. 103(a) as being unpatentable over Davey et al (US 6,576,341) in view of Dillon et al (US 20020150529).

Davey et al disclose a process for making polymer wrapped (coated) carbon nanotubes comprising the steps of adding nanotube soot to a solvent which includes a nanotube extracting polymers having coiling structure (See column 3, lines 45-46) such as poly(m-phenylene-co-2,5-dioctoxy-p-phenylenevinylene), poly(dioctyl fluorene) or polysulphonic acid (surfactant) (See column 3, lines 25-32) to form a solution (i.e. polymer and nanotubes are added sequentially); mixing the solution to form a nanotube composite suspension while allowing the undesirable solid materials such as amorphous carbon to settle out (i.e. wrapped carbon nanotubes are substantially free of amorphous carbon) (See column 3, lines 42-46); removing the nanotube composite suspension (See column 3, lines 33-61). Conveniently, the solution is mixed by sonication using ultrasonic bath, but any other suitable mixing method may be used (See column 3, lines 62-63). Any suitable solvent which can solubilise the nanotube extracting material can be used (See column 3, lines 55-57). The polymer-coated carbon nanotubes can be blended with other plastics (See column 8, lines 12-13) in injection moulding (See column 8, line 12).

Davey et al teach that the term *nanotube* is taken to mean ***any nanostructure and related materials***. The nanotubes which are mixed with polymers can be in the form of carbon nanotubes, nanotubes of other materials such as vanadium pentoxide for example, nanostructures (regular and undefined), as well as derivatives of these which can be based on or contain, as an example, Silicon, Boron, Tin, nitrogen, compounds of vanadium and oxygen such as vanadium pentoxide, etc. The nanostructures can have dimensions from nanometers in length to millimeters in length, as well as nanometers in width to micrometers in width. See column 3, lines 8-23.

It is the Examiner's position that a suitable solvent, which can solubilise the poly(sulphonic acid) polymer is water.

Davey et al fail to teach that carbon nanotubes include aggregates of SWNTs so that aggregates of SWNTs can be wrapped using the method (Claim 28); SWNTs in the aggregates are substantially free of amorphous carbon (Claim 32); the aggregates of SWNTs comprise ropes of SWNTs which are substantially aligned along their longitudinal axes (Claim 29) or bundles of SWNTs which are substantially aligned along their longitudinal axes (Claim 30); the aggregates of SWNTs are coated with at least two polymers (Claim 31); the polymer and the aggregates of SWNTs are added to the solvent simultaneously (Claim 34); the concentration of the aggregates of SWNTs in the solvent is between about 0.1 grams/liter and about 5 grams/liter (Claim 37); the concentration of polymer in the solvent is between about 1.0 percent and about 5.0 percent by weight (Claim 38).

Dillon et al teach that purified SWNTs free of amorphous carbon readily agglomerate forming bundles in a solvent when ultrasonic agitation is turned off. The extent of collapse of the bundle into a *tight* bundle depends upon solvent composition. Water produces more tight bundles. The tight bundles (aggregates) probably arise from the *minimization* of the interactions between *hydrophobic* SWNT surfaces and the *hydrophilic* solvent (e.g. water) **maximizing** the Van der Waals interactions along the axial length of the tubes thereby aligning SWNTs (See P47). Normally, SWNTs are not dissociated in aqueous solution without the use of surfactants. With the use of the ultrasonic probe, the SWNT sample was almost immediately dispersed throughout the solvent. If the sonicated solution is allowed to settle, SWNT superbundles are observed at the solvent interface. See PP46, 47. In other words, purified SWNTs (i.e. free of

amorphous carbon) might form tight bundles (aggregates) of aligned SWNTs if water is used as a solvent and mixing means are much less intense than sonication.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used SWNTs containing soot, water as a solvent, and mixing means that are much less intensive than sonication in a method of Davey et al with the expectation of providing the desired wrapped bundles of aligned SWNTs if wrapped bundles of aligned SWNTs are required, since Davey et al teach that nanotubes of any nanostructure can be wrapped using the method, and Dillon et al teach that tight bundles (aggregates) of aligned SWNTs will be formed from the minimization of the interactions between hydrophobic SWNT surfaces and the hydrophilic solvent and maximizing the Van der Waals interactions along the axial length of the tubes if water is used as a solvent, and the sonicated solution is allowed to settle.

As to claim 31, it is held that it is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition to be used for the very same purpose. In re Kerkhoven, 626 F.2d 846, 850, 205 USPQ 1069, 1072 (CCPA 1980). See also In re Crockett, 279 F.2d 274, 126 USPQ 186 (CCPA 1960); and Ex parte Quadranti, 25 USPQ2d 1071 (Bd. Pat. App. & Inter. 1992).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined at least two polymers as extracting material in a method of Davey et al in view of Dillon et al with the expectation of providing the desired wrapped carbon nanotubes since it is held that it is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition to be used for the very same purpose.

As to claim 34, it is held that sequence of adding ingredients is obvious absent a showing of criticality. In re Gibson 5 USPQ 231, 232 (CCPA 1930).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have added a polymer and SWNTs in a method of Davey et al in view of Dillon et al simultaneously to water since it is held that sequence of adding ingredients is obvious absent a showing of criticality.

As to claims 37, 38, it is held that concentration limitations are obvious absent a showing of criticality. Akzo v. E.I. du Pont de Nemours 1 USPQ 2d 1704 (Fed. Cir. 1987).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant concentration parameters (including those of claims 37, 38) in a method of Davey et al in view of Dillon et al through routine experimentation in the absence of a showing of criticality.

7. **Claims 39-42** are rejected under 35 U.S.C. 103(a) as being unpatentable over Davey et al (US 6,576,341) in view of Dillon et al (US 20020150529), further in view of Tohji et al (Fullerene Science and Technology, 7(4), 665-679, 1999).

Davey et al in view of Dillon et al are applied here for the same reasons as above. Davey et al in view of Dillon et al fail to teach that solvent is heated to a temperature at least 40 °C (Claim 39) or between about 50⁰C and about 60⁰C (Claim 40) for 0.1-100 hours (Claim 41) or for 1-50 hours (Claim 42).

Tohji et al teach that treating soot containing fullerenes including SWNTs with boiling water untangles the fullerenes from the soot (See page 666, P2; page 672, P2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have heated a mixture of SWNTs with accompanying soot and polymer in water in Davey et al in view of Dillon et al with the expectation of providing the desired improved separation of the SWNTs and bundles (aggregates) of SWNTs from the soot, since Tohji et al teach that treating fullerene soot with boiling water untangles the fullerenes such as SWNT from the soot.

As to the temperature and time, one of ordinary skill in the art at would know that effect of heat treating depends on temperature and time of treating so that the same result as treating at high temperature and short period of time can be achieved at lower temperature but for longer time.

In other words, time and temperature are result effective parameters in a heating process.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant temperature and time parameters (including those of claimed invention) in a method of Davey et al in view of Dillon et al in view of Tohji et al through routine experimentation in the absence of a showing of criticality.

8. **Claim 46** is rejected under 35 U.S.C. 103(a) as being unpatentable over Davey et al (US 6,576,341) in view of Dillon et al (US 20020150529), further in view of Bower et al (EP 989579).

Davey et al in view of Dillon et al, as applied above, fail to teach that the method further comprises the step of aligning the nanotubes by application of an external field selected from the group consisting of an electrical field, a magnetic field and a shear flow field.

Bower et al teach that a mixture of carbon nanotubes such as SWNT and/or MWNT (See column 6, lines 7-10) and polymers in solvents in the form of a solution or slurry (See column 9, lines 38-40), applied to a substrate can be aligned by application of magnetic and/or electric fields in order to reduce the overall energy of the system (See claim 15; column 10, lines 18-43, 56).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have aligned polymer-coated nanotubes in Davey et al in view of Dillon et al by application of an external magnetic and/or electric fields with the expectation of providing the desired reduced overall energy of the system since Bower et al teach that a mixture of SWNT and/or MWNT and polymers applied to a substrate can be aligned by application magnetic and/or electric fields in order to reduce the overall energy of the system.

9. **Claim 47** is rejected under 35 U.S.C. 103(a) as being unpatentable over Davey et al (US 6,576,341) in view of Dillon et al (US 20020150529), further in view of Shaffer et al (Advanced materials, 11, No. 11, 1999).

Davey et al, as applied above, further teach that any polymer preferably of coiling structure can be used for wrapping carbon nanotubes (See column 3, lines 1-7). However, Davey et al/in view of Dillon et al fail to teach that the polymer is polyvinyl alcohol.

Shaffer et al teach that polyvinyl alcohol can be used for covering carbon nanotubes in water by mixing (See page 938, P3).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used polyvinyl alcohol as a polymer in Davey et al in view of Dillon et al

since Shaffer et al disclose polyvinyl alcohol is suitable for covering carbon nanotubes in water by mixing.

It is held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious); *Ryco, Inc. v. Ag-Bag Corp.*, 857 F.2d 1418, 8 USPQ2d 1323 (Fed. Cir. 1988).

10. **Claim 49** is rejected under 35 U.S.C. 103(a) as being unpatentable over Davey et al (US 6,576,341) in view of Dillon et al (US 20020150529), further in view of Hsu et al (US 6,333,598).

Davey et al in view of Dillon et al are applied here for the same reasons as above. Davey et al in view of Dillon et al fail to teach that the solvent further comprises a surfactant such as sodium dodecyl sulfate.

Hsu et al teach that carbon nanotubes can be treated with a micellar surfactant such as sodium dodecylsulfate (SDS), which attach to the nanotube in a shell, to provide negatively-charged end groups that project outward to the water phase, which end groups will preferentially attach to a hydrophobic (e.g., octadecanethiol-coated noble metal) surface but would not attach to negatively charged surfaces (See column 15, lines 5-19).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have added sodium dodecylsulfate to the solvent in a method of Davey et al in view of Dillon et al with the expectation of providing the desired attachment to hydrophobic (e.g.,

octadecanethiol-coated noble metal) surface, and not to negatively charged surfaces depending on particular application, as taught by Hsu et al.

Allowable Subject Matter

11. **Claims 44, 45, 50** are objected to as being dependent upon a rejected base claims 11 and 20, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elena Tsoy whose telephone number is (571) 272-1429. The examiner can normally be reached on Mo-Thur. 9:00-7:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Elena Tsoy
Primary Examiner
Art Unit 1762

ELENA TSOY
PRIMARY EXAMINER

A handwritten signature in cursive script, appearing to read 'ETsoy', is written over the printed name and title.

November 10, 2004